Appendix E

Cummins Engine Company -- Proposed Environmental Projects

Cummins Engine Company will undertake the following projects as Environmental Projects, pursuant to Section IX.C. Specific proposals for project expenditures total eighteen million seven hundred fifty thousand dollars ($18,750,000) and include thirteen million seven hundred fifty thousand dollars ($13,750,000) (which is 55% of the proposed Additional Injunctive Relief/Environmental Project financial target, less Incentive Program credit), plus five million dollars ($5,000,000) to satisfy the State of California requirements. An additional six million two hundred fifty thousand dollars ($6,250,000) in Environmental Projects are to be planned subsequent to the comment period.

Technical and financial targets for each project will be refined in detailed planning following entry of the Consent Decree. The total amount to be spent by The Company will not be affected; however, the specific amounts allocated to each of the Environmental Projects may be adjusted up or down in view of the improved understanding of the elements of work and associated expense.

1. Chassis Dynamometer Vehicle Test Program $ 2.2 million

EPA, CARB and other emissions regulatory agencies have expressed interest in developing a broader understanding of in-use emissions from heavy-duty engines. This program will investigate the effect of engine use on emissions over time, and will begin to establish a database to correlate in-use, chassis-dynamometer-test, and engine-dynamometer-test emissions. The test program will establish baseline engine and vehicle emissions, track the engine through service, and test emissions periodically through the useful life period. The proposed test sequence for each engine is as follows:

1. Engine dyno emissions baseline;
2. Vehicle emissions baseline;
3. Vehicle emissions at 1/3, 2/3 and 3/3 Useful life;
4. Engine dyno emissions at Useful Life.

The engine sampling and test program will begin when the vehicle facility is operational (target 6/2001). The proposed program will involve 30 on-highway engines in total: 10 engines from each of three successive model years: MY 2001, MY 2002, and MY 2003. Of the 30 engines, 18 will be HHDDE Truck HDDEs Engines, 6 will be MHDDE Truck HDDEs Engines, and 6 will be LMB engines.

2 **Exhaust Aftertreatment Research (1999-2004) and Demonstration Programs** **$12.2 million (Includes $2.8MM for California)**

Future low-emission engine systems must rely on engine + aftertreatment architectures that can deliver both decreases in exhaust emissions along with improved performance for the customer: improved fuel economy (decreasing CO_2), lower total cost of ownership, greater reliability, longer durability, and ease of service.

The Additional Offset Projects in this group will focus on advanced aftertreatment technologies that will be applied after 2002. Effective exhaust aftertreatment systems will allow the combustion process to be optimized for improved efficiency and for other performance characteristics, while controlling emissions downstream in the exhaust system. Final production engine + aftertreatment systems are likely to incorporate technology elements from two or more of these approaches, so that systems analysis and testing to integrate engine and NOx + particulate aftertreatment is an important part of the planned work.

Our research targets, which form the context for all of our advanced development programs, are 1.0 gm/bhp-hr NOx and 0.05 gm/bhp-hr particulates.

The primary exhaust aftertreatment technologies to be investigated in these projects are:

1. NOx reduction: lean NOx catalysts (LNC), adsorption catalysts (AC), and Selective Catalytic Reduction (SCR);

2. Particulate reduction: passive catalyzed particulate traps (PCPT) and microwave regenerated silicon carbide particulate traps (MSCT).

Cummins will evaluate each technology listed above at the analytical and bench-laboratory level at a minimum. All viable technologies will be carried on to the next level of testing at each step of the program. The Company believes this will make it more likely that a broad spectrum of technologies will be available to support technical feasibility of lower emission standards in the future, possibly for non-road as well as on-highway applications.

In addition to developing these technologies as subsystems for Cummins products, the Company will also evaluate the passive catalyzed particulate trap (PCPT) as a possible diesel retrofit system for urban bus and other urban vehicle applications.

The Company expects to conduct at least two specific field demonstration programs of exhaust aftertreatment systems - as

determined through discussions with EPA, when the results of the research are available. In addition to the above listed NOx reduction technologies, plasma assisted catalytic reduction (PACR), which is already the subject of a research CRADA between Cummins and Lawrence Livermore National Laboratories, will also be considered for field demonstration

3. Alternative Fuel Technology and Engine Program $ 4.4 million (Includes $2.2MM for California)

a. Natural gas advanced ignition system project. This project is directed at developing a novel ignition system for stable lean combustion. If successful, the design will be demonstrated in field test and then developed into a commercial product.

b. Gaseous fuel delivery system project. This project is directed at developing a reliable, robust fuel delivery and control system for lean combustion. If successful, the design will be demonstrated in field test and then developed into a commercial product.

c. The above technologies will be applied to develop a new natural gas engine platform, initially targeted at urban bus applications, with emission targets of less than 1.0 g/bhp-hr NOx and less than 0.05 g/bhp-hr particulate. This engine will be demonstrated in a multiple-vehicle field test as part of the development program.

State of California Environmental Projects

Proposed projects to satisfy the requirements of the State of California are included in the above list.

Sub-program expense estimates are broken out below for specific consideration by the State of California:

Chassis Dynamometer Vehicle Test Program:
Specific engines may be chosen for test according with the interests of the State of California. The estimated per-engine expense for this project is $75,000.

Exhaust Aftertreatment:
Passive Catalyzed Particulate Trap demonstration program (Alameda Transit): $2.5-3.0 million

a. Duty cycle analysis (minimum 5 vehicles) – 4Q98-2Q99
b. Pilot program (minimum 10 vehicles) – 2Q99-2Q00
c. Fleet demonstration (up to 200 vehicles) – beginning 2Q00

Note that the Plasma Assisted Catalytic Reduction research and development is being done in cooperation with Lawrence Livermore National Laboratories. The Environmental Project expense associated with this technology, if any, will be for product prototype development and field demonstration.